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NEW FEATURE COMING!

I think it's about time to do some elementary circuit analysis starting this month and continuing in the issues ahead. There are many slick and wicked circuits in the current crop of scanners on the market and if you know how they work, it might help you become a better hacker. At the least, you might be able to "copy" or emulate some of these circuits for your own hacking and experimenting needs around shop and shack. This month, we're going to take a close look at the Low Battery Warning and Memory Retention circuits in the venerable PRO-2004/5/6 scanners.

Each month, I'll try to dissect and explain a new circuit from these and other scanners. Your preferences are very important, so if you have a pet peeve or favored circuit that you'd like to better understand, just let me know so I can put it on the list. This offer is pretty much limited to scanners for which I have Service Manuals on file. If I don't have the manual, you'll be expected to provide it, else do without the analysis. Use postal mail, e-mail, fax, or the *Hertzian Intercept BBS* to get your request on the list. You can also register it by voice phone with Cindy during our normal voice phone hours, if you like.

PRO-2004/5/6 LOW BATT CIRCUIT EXPLAINED

The Low Battery Warning indicator in the PRO-2004/5/6 is a work of art, and just complicated and mysterious enough to confuse many wannabe hackers. It also screams for a little improvement here and there, so let's take a detailed look at the meat 'n taters of this circuit and see what can be done with it. It's pretty slick and yet easily understood with just a little guidance. See the above drawing of the Low Battery Indicator circuit for the PRO-2005/6 which is identical to that of the PRO-2004 except for circuit symbols.

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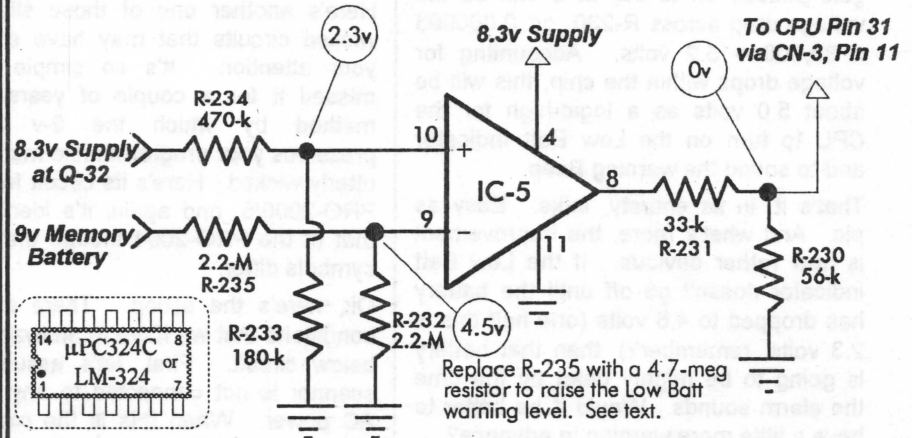
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PRO-2005/6 LOW BATT WARNING CIRCUIT

(Identical for PRO-2004 though circuit symbols may differ)



The heart of this circuit is IC-5, a basic op-amp of the 324 type....common as fleas on a junkyard dog. IC-5 is a 4-section op-amp, only one of which is shown above. The three remaining sections are used for other purposes in the scanner and are not relevant to this discussion.

Op-amps are neat little chips with a variety of uses, from basic amplifiers to, in this case, voltage comparators! As the name implies, this circuit *compares* one voltage to another and makes a logical decision accordingly. Specifically, a preset reference voltage is applied to Pin 10, the non-inverting (+) input, while the memory battery voltage is applied to Pin 9, the inverting (-) input of the op-amp. In this specific configuration, the output at Pin 8 will be zero-volts so long as the battery voltage input is higher than the reference voltage input. As the battery weakens over the months, its voltage will steadily drop until at some point, it falls below the established reference voltage, at which time the output at Pin 8 goes high to Vcc or +8.3 volts.

The CPU senses the low and high logic, and acts accordingly, or in this case, does nothing while the reference is lower than the battery voltage. When the output shifts to a "high", the CPU senses it and turns on the Low Batt indicator in the display and performs a repetitive Beep until you change the battery. Now let's look in detail at how this happens.

The Memory Battery voltage feeds other parts of the scanner, but it also directly feeds the point shown in the diagram above. A fresh 9-v battery will produce at least 9.0 volts to this point. Now look at the two resistors, R-235 and R-232, each 2.2-M Ω . Skipping the math for a moment, because they're equal, each resistor will drop one half the batter voltage, or 4.5-v each for starters. This puts 4.5v at Pin 9 of IC-5. Now the math, lest some thing the battery will prematurely drain. Two 2.2-M Ω resistors in series with the battery are the equivalent of 4.4-M Ω . Using Ohm's Law, where current equals voltage divided by resistance, we have $I = 9 \div 4,400,000$ or 0.000002045 amps, or 2- μ a. There's your answer: a 9-v battery can generate 2- μ a for a year or more. No sweat. The idea was to get a sample of the battery voltage at Pin 9 of IC-5. So one half the battery voltage will always be at Pin 9.

Now let's look at the reference circuit. We see where it is fed from the scanner's +8.3v supply through R-234 and R-233, 470-k Ω and 180-k Ω , respectively. Again using Ohm's Law, $8.3v \div 470-k + 180-k$ equals 12.8- μ a. The voltage at Pin 10 will be the voltage dropped across R-233, or: $180,000 \times 0.0000128 = 2.3$ volts. This, then, is the reference voltage at Pin 10, which will not change.

Now it becomes clear: as the battery weakens from its starting 9 volts, exactly one half the voltage, whatever it is, will

be applied to Pin 9. When the voltage at Pin 9 gets to be 2.3-v, the output at Pin 8 of IC-5 will shift from 0-volts to the supply voltage of 8.3 volts. (low to high). But wait!!

The CPU is a 5-volt device and would be destroyed if punched with 8.3v logic. Ahhhh, but that's what R-231 and R-230 are for: protection! They form a voltage divider, just like the previous two examples, so we can once again use Ohm's law: $I = 8.3 \div 33\text{-k} + 56\text{-k}$ or: $I = 8.3 \div 89\text{-k} = 93\text{-}\mu\text{a}$. The voltage that gets passed on to the CPU will be the voltage drop across R-230, or: $0.000093 \times 89,000 = 5.2$ volts. Accounting for voltage drops within the chip, this will be about 5.0 volts as a logic-high for the CPU to turn on the Low Batt Indicator and to sound the warning Beep.

That's it, in its entirety, folks. Easy as pie. And what's more, the improvement is now rather obvious. If the Low Batt indicator doesn't go off until the battery has dropped to 4.6 volts (one half this is 2.3 volts, remember?), then that battery is going to be mighty dead by the time the alarm sounds. Would it be better to have a little more warning in advance?

Easy as 1-2-3. We'll keep the same reference voltage of 2.3-v on Pin 10, but change the circuit of R-235 and R-232 to set the ratio that we want. My idea for a better alarm point is 6.0 or even 7.0 volts....let's say 7.0 volts. Ok, it will still take 2.3v or less on Pin 9 to trigger the alarm, but if we increase the value of R-235 to drop more voltage than R232, then that 2.3-v point will be reached sooner than under stock conditions. Let's calculate how:

Assuming 7-v is applied to R-235, and we want 2.3-v on Pin 9, that means R-232 will have to still drop 2.3-v. That leaves 4.7v to be dropped by R-235. Current equals $2.3\text{v} \div 2,200,000\Omega = 1.045\text{-}\mu\text{a}$. That same current has to flow through the new R-235, which equals voltage divided by current:

$4.7\text{v} \div .00001045 = 4.49\text{-M}\Omega$ Cool! Let's replace R-235 with a common 4.7-M Ω resistor instead of fussing with the nonsense fractional value. Now let's finalize the calculations:

$4.7\text{-M}\Omega + 2.2\text{-M}\Omega = 6.9\text{-M}\Omega$ total series resistance. Now, when 2.3v is dropped across R-232, 1.045- μa flows through it as well as through the new R-235: The voltage across the new R-235 at that time will be $.00001045 \times 4.7 \text{ M}\Omega$ or 4.9-v. Finalizing, 4.9v in series with the 2.3-v equals 7.2-volts, the point at which the Low Batt Indicator will come on and the alarm will sound! We already determined that 4.5-M Ω will trigger at 7.0-v, and obviously, 2.2- M Ω triggers at

4.5-v, so there's the pattern and the idea for how to raise your Low Batt Warning Indicator to a more reasonable level. You could substitute a 5- M Ω or 10- M Ω trimmer potentiometer for R-235 and adjust your own trigger point. Got the idea here? If not, ask me questions.

PRO-2004/5/6 MEMORY BATTERY EXPLAINED

Here's another one of those slick and wicked circuits that may have escaped your attention. It's so simple that I missed it for a couple of years. The method by which the 9-v battery preserves your programmable memory is utterly risky. Here's its circuit from the PRO-2005/6, and again, it's identical to that of the PRO-2004 though the circuit symbols differ.

Ok, here's the scoop. There are two conditions that we have to analyze in the below circuit. First, let's assume the scanner is not connected to any DC or AC power. When this is the case, the CPU and SRAM memory chip will lose their memory contents unless +5v is somehow supplied. No sweat, the 9-v battery feeds through D-59 and R-247 into IC-9, a very special CMOS voltage regulator that produces a steady, stable +5v output over a wide range of inputs, from about 5v to 15v or so. Hence, the 9v battery is more than capable.

The neat thing here is that IC-9 is so special that it consumes almost no current on its own, unlike most voltage regulators that drop 2½-3 volts and need several milliamps just to operate. This would drain the battery in no time. IC-9 is very special in that respect and can't be found on just any street corner. It drops almost no voltage and consumes only a few billionths of an amp. When

not operating, the CPU and SRAM memory also consume only a few billionths of an amp, so this may explain why the battery can last for six months or longer when the scanner is not connected to power.

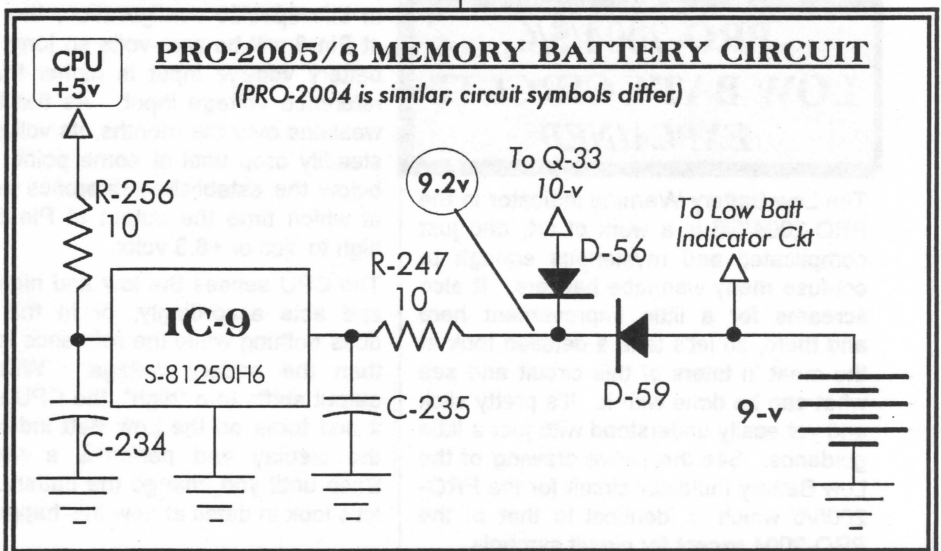
Continuing, resistors R-247 and R-256, ten ohms each, do little more than serve as current limiters to protect IC-9 in the event of a short circuit somewhere in the CPU area. These resistors are not important in the rest of this analysis because at the low currents we're dealing with, they drop almost no voltage.

This about wraps up the no-power condition of the memory battery analysis. Now, let's look at what happens when the scanner is plugged into either AC or DC power, no matter whether it is turned on or off.

A closer study of the schematic diagram reveals that the AC power supply is not switched by the on/off switch. If plugged into 110-VAC, the internal power supply is on full time and generating full DC voltage of about 12-13 volts. This DC voltage is switched, however, which turns the scanner on and off. However, a portion of that DC is fed to Q-33 to generate a 10-volt output into D-56.

This same condition applies, even if AC is disconnected and an external DC supply is used. Q-33 is fed with full-time power so long as the scanner is connected to either AC or DC. This has the effect of applying about +9.2v to the cathode of D-56 and the anode of D-59.

Voile! This turns off any possible current flow from the battery because the cathode of D-59 becomes more positive (+9.2v) than its anode fed by the (+9.0v) battery! A diode is an OFF switch when its cathode is more positive than the anode (reverse bias). Summary: the battery cannot pass current through D-59 when the scanner is connected to any power! Yet, when it is disconnected, the



anode of D-59 being more positive than the cathode, will conduct thereby allowing the battery to feed IC-9.

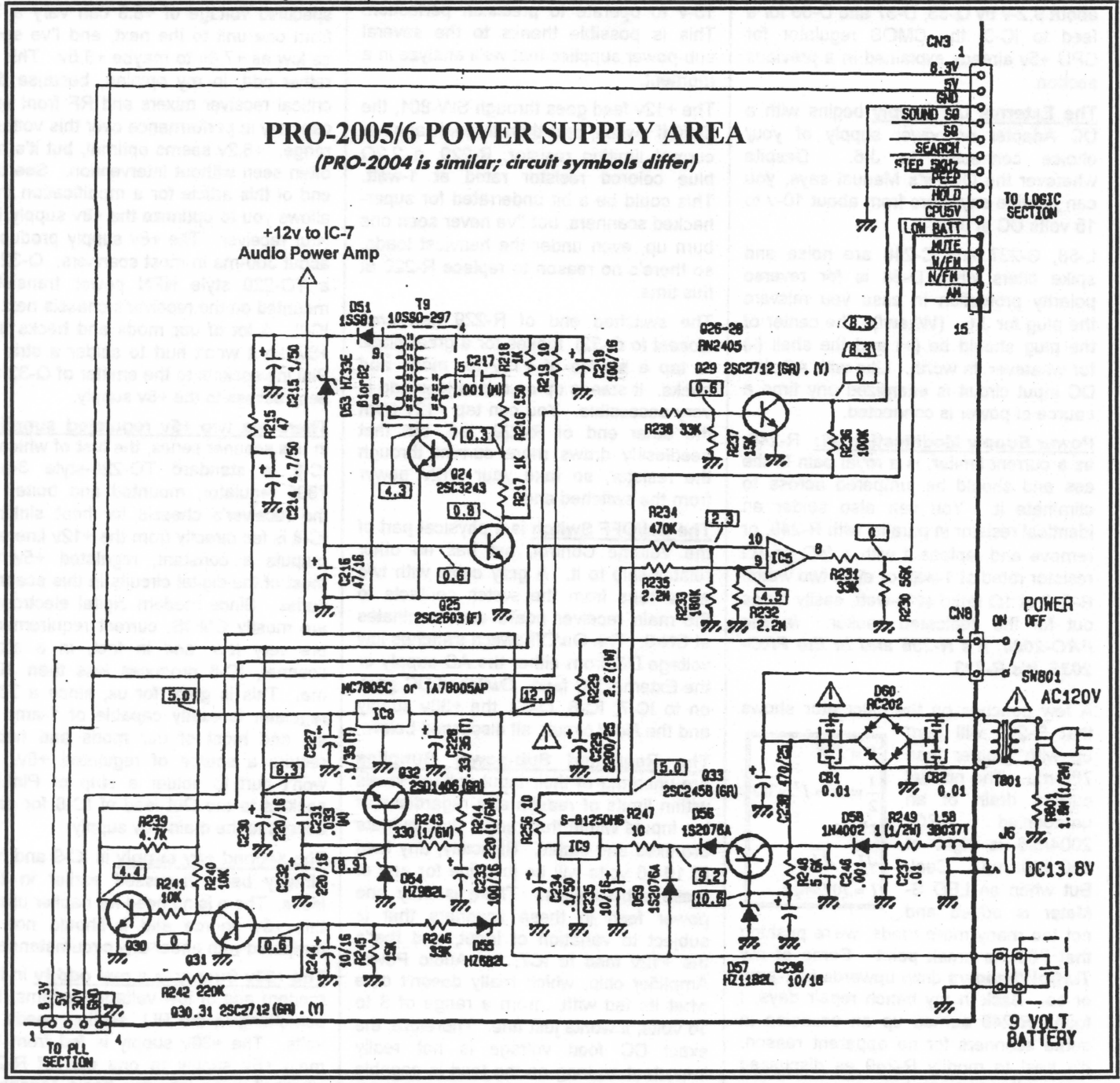
Concluding, then, when AC or DC power is connected to the scanner, Q-33 provides a continuous feed to IC-9, which in turn, produces the +5v "keep alive" power necessary to preserve the memory of the CPU and SRAM. If and when power is removed from the scanner, the battery instantly takes over the feed to IC-9. The major player in this action is D-59, which turns the battery feed on and off as needed. Interestingly enough, the PRO-2004/5/6 can lose both regular power and the memory retention battery supply for short periods (10-30 mins) without loss of memory. I suppose this is due to a number of capacitors in the CPU +5v line which retain their charge for a

time. Thanks also to the extremely low "deep sleep" current requirements of the CPU and SRAM.

There really isn't anything to modify in this circuit, or that needs modification, for that matter. I did replace the equivalent of R-247 in my PRO-2004 with a 47Ω resistor because in my tinkering, I inadvertently blew IC-9 a couple of times and got tired of paying Tandy several bucks a pop for the privilege. In my opinion, 10Ω is a bit too small. On the other hand, I've not blown IC-9 since those first couple of times, so maybe this issue is not worth even a mention. It is something you can do if ever IC-9 gets popped for whatever reason. Otherwise, this circuit is best left alone and allowed to function as designed.

PRO-2004/5/6 POWER SUPPLIES EXPLAINED

The previous two circuit analyses literally scream for an explanation of the power supplies in the PRO-2004/5/6, so it may as well be done here and now where it fits best of all. The below diagram is a schematic of the PRO-2005/6 power supply, with superfluous circuits and traces deliberately erased to simplify the viewing and understanding of what's going on here. The PRO-2004 and PRO-2035 power supplies are very similar, but circuit symbols will differ, and there are minor differences here and there.



The AC Supply starts with the power cord that feeds directly to T-801 with no on/off switches in series. Thus, T-801 is energized any time the scanner is plugged into AC power. T-801 is a step-down transformer, reducing 110-vac to about 10-12 VAC. C-82 & C-81 are noise and spike filters. R801 is a high resistance shunt to chassis ground, probably for static dissipation.

The low voltage AC is rectified into pulsating 120-Hz DC by full-wave bridge rectifier D-60, and filtered into a smooth, ripple-free 12-13 vDC by C-238 (and C-229). The path splits with one side going to the On/Off switch and the other to the emitter of Q-33 at the junctions of R-248, C-246 and D-58. DC power is full-time at this point where it is roughly regulated to about 9.2-v by Q-33, D-57 and D-56 for a feed to IC-9, the CMOS regulator for CPU +5v already explained in a previous section.

The External DC Supply begins with a DC Adapter or power supply of your choice connected to J-6. Despite whatever the Owner's Manual says, you can provide anywhere from about 10-v to 15 volts DC at J-6.

L-58, C-237 and C-246 are noise and spike filters while D-58 is for reverse polarity protection in case you miswire the plug for J-6. (*Whew!*) The center of the plug should be (+) and the shell (-) for whatever its worth. Like with AC, the DC input circuit is energized any time a source of power is connected.

Power Supply Modification #1: R-249, as a current limiter, is a royal pain in the ass and should be jumpered across to eliminate it. You can also solder an identical resistor in parallel with R-249, or remove and replace it with a 1/2Ω or 1Ω resistor rated at 1-watt or even two watts! R-249 at 1Ω rated at 1/2-watt, easily burns out for the dedicated hacker. *In the PRO-2004, it's R-256 and in the PRO-2035, it's R-223.*

A few punches on the calculator shows that R-249 will burn up with greater than 700-ma. The normal current drain of an unmodified PRO-2004/5/6 is right at 350-400 ma. Cool. But when an LED S-Meter is added and not too many more mods, we're pushing that 700-ma break point. Some of my *TurboWhoppers* draw upwards of 1-amp or so. Back in my bench repair days, I found R-249 burned up on occasion in some scanners for no apparent reason. It's best to modify R-249 as discussed and get it out of your hair.

$$P = I^2 R$$

$$\frac{1}{2} \text{ watt} = I^2 \times 1\Omega$$

$$I^2 = .5$$

$$\sqrt{I} = \sqrt{.5}$$

$$I = .707 \text{ amps}$$

Power Supply Modification #2: The dedicated hacker will run into all kinds of power supply problems in time, so I always recommend removal of the AC supply altogether and running strictly from a source of external DC at J-6. Remove T-801, the AC power cord; and R-801. You'll end up with lots more "real estate" for other mods, and your scanner will run cooler by a substantial margin.

Continuing.....The outputs of both the AC power supply and the External DC feed path meet at a common point in the scanner best described as the junctions of Q-33, R-248, C-246, D-58, C-238, and the hot side of SW-801, the On/Off switch. Basically, the scanner doesn't care which feed you choose because it needs a very uncritical range of 10v to 15-v to operate to precision perfection. This is possible thanks to the several sub-power supplies that we'll analyze in a moment.

The +12v feed goes through SW-801, the On/Off switch, and then through another current limiting resistor, R-229, a 2.2Ω blue colored resistor rated at 1-watt. This could be a bit underrated for super-hacked scanners, but I've never seen one burn up, even under the heaviest loads, so there's no reason to replace R-229 at this time.

The switched end of R-229 (*left end, closest to Q-32*), makes for a great place to tap a source of +12v for mods and hacks. It stands up on raised legs and is very accessible. You can tap +12v from the other end of R-229, too, but that needlessly draws more current through the resistor, so take your +12v power from the switched end.

The ON/OFF Switch is a physical part of the Volume Control, but has no other relationship to it. A gray cable with two wires runs from the switch contacts to the main receiver board and terminates at CN-8. The On/Off switch switches low voltage DC from either the AC supply or the External DC feed. Switched DC goes on to IC-7, IC-8, Q-32. the +30v supply and the *Hold* circuit, all discussed below.

The Regulated Sub-power Supplies are uncaring of their input voltage levels within limits of reason and regardless of the inputs within that range, their outputs are fixed and stable. Basically, any feed of 10-16 volts will be just fine for any of these sub-supplies. There is only one power feed in these scanners that is subject to variation of input, and that's the +12v feed to IC7, the Audio Power Amplifier chip, which really doesn't care what its fed with....from a range of 8 to 16 volts, it works just fine. Therefore, the exact DC feed voltage is not really important so long as the feed is capable of generating the current we need, which

is about 400-ma for a stock scanner and upwards of 1-amp for us hackers. **Your external DC Supply or Adapter should be rated at 12-14 volts at one amp, at a minimum. Unregulated will be ok.**

The +12v common feed from either the AC supply or the External DC supply goes no where else, aside from the Audio Amplifier, and to the inputs of the several sub-supplies that we'll discuss next.

The +8v Regulated Supply is the predominant provider in the PRO-2004/5/6 and PRO-2035. +12v feeds the collector circuit of Q-32, which is biased at its base by zener diode, D-54 to producing approximately +8.3v at the emitter of Q-32. Almost all the analog electronics in these scanners are powered from the emitter of Q-32. The specified voltage of +8.3 can vary a lot from one unit to the next, and I've seen as low as +7.8v to maybe +8.5v. This is rather odd, in my opinion, because the critical receiver mixers and RF front end can vary in performance over this voltage range. +8.2v seems optimal, but it's not often seen without intervention. See the end of this article for a modification that allows you to optimize the +8v supply for your receiver. The +8v supply produces about 300-ma in most scanners. Q-32 is a TO-220 style NPN power transistor mounted on the receiver's chassis next to IC-8. A lot of our mods and hacks use +8v, so it won't hurt to solder a strip of PinLine sockets to the emitter of Q-32 for easy access to the +8v supply.

There are two +5v regulated supplies in this scanner series, the first of which is IC-8, a standard TO-220-style 3-port 7805 regulator, mounted and bolted to the receiver's chassis for heat sinking. IC-8 is fed directly from the +12v line and outputs a constant, regulated +5v for most of the digital circuits in this scanner series. Since modern digital electronics are mostly CMOS, current requirements are very low, and in fact, in a stock scanner, IC-8 produces less than 100-ma. This is great for us, since a 7805 regulator is easily capable of 1-amp or so, and most of our mods and hacks require a source of regulated +5v. It won't hurt to solder a strip of PinLine sockets to the Out lead of IC-8 for easy access to the main +5v supply.

The second +5v supply is IC-9 and has already been discussed earlier in this issue. There is no need for hacker use of this +5v source and it should not be tampered with under any circumstances.

The +30v Supply is a real oddity in this modern age of low voltage systems, but something in the PLL section needs 30 volts. The +30v supply is fed from the main +5v supply to one end of R-219 where it goes into the basic "chopper"

circuit of Q-24, Q-25, and T-9, where the +5v DC is chopped into a pulsating DC; stepped up by T-9; to about 30-vAC; rectified and regulated by D-51 and D-53, and filtered to a smooth 30-vDC by C-215, R-215, and C-214. That's all that's worth telling about the 30-v supply. It has no interest to us hackers and it should not be tampered with under any circumstances.

The "Hold" Circuit isn't really a power supply, but there's no good subject area to tell about it anywhere else. Since it's located in the power supply area of the schematic, we'll dissect it here.

Let's see what this sucker does before drawing any conclusions. **Unswitched** (continuous) +12v feeds the Hold Circuit at D-55 which with R-246, R-245, and C-244, forward biases Q-31 into conducting and driving its collector low. This "low" appears on the base of Q-31 to turn it off, where +4.4v then appears on the collector. This 4.4v can loosely be referred to as "+5v" high logic, which becomes pertinent as we follow the path from the collector of Q-30 to R-238 and the base of Q-29. This "high" appears on the base of Q-29, thereby shutting it off, making a "low" appear on its collector. Following the collector path of Q-29, we find that it goes to CN-3, Pin 9, where it is labeled "Hold". Huh?

Ok, so we follow that path onto the Logic-CPU Board where it goes to the CPU, Pin 17. Nothing else in the Service Manual is said about this "function", but we can make some educated guesses after one more analytical effort.

Since continuous +12v feeds this Hold function, let's see what happens if power is removed from the scanner. In that case, Q-30, 31 and 29 cannot possibly conduct. But lo! The memory retention CPU +5v from IC-9 will place a +5v "high" at CN-3, Pin 9 via R-236, just the opposite from the low that is normally there when the scanner has any power applied to it!

Aha! My conclusion is that when power is removed, this +5v high at CPU Pin 17 causes it to go into "**deep sleep**" mode thereby minimizing the current required from the Memory Retention Battery. Not exactly a power supply, this "Hold" function, but now you know all about it. I'd leave it alone, if I were you. It offers nothing of interest to the hacker.

This concludes our first effort at circuit analysis of a popular series of scanners. If you have questions or if you want to see other analyses, then fire away. I'm your analyst. Just read page 1 in this issue first, and make sure I have the Service Manual for your scanner. I have many Realistics and a few Unidens.....

900 MHz CORDLESS PHONE FREQS

The Jan-Feb 1995 issue of the "American Scannergram" shows the 900 MHz freqs used by Panasonic and Radio Shack cordless telephones. Apparently there is no official band plan because as you can see, the only similarities are the band edges and 30 KHz spacing. 900 MHz phones from other manufacturers are reported to differ as well.

Panasonic			Radio Shack		
Ch	Base	Handset	Ch	Base	Handset
01	902.100	926.100	01	902.120	926.120
02	902.130	926.130	02	902.150	926.150
03	902.160	926.160	03	902.180	926.180
04	902.190	926.190	04	902.210	926.210
06	902.220	926.220	05	902.240	926.240
06	902.250	926.250	06	902.270	926.270
07	902.280	926.280	07	902.300	926.300
08	902.310	926.310	08	902.330	926.330
09	902.340	926.340	09	902.360	926.360
10	902.370	926.370	10	902.390	926.390
11	902.400	926.400	11	902.420	926.420
12	902.430	926.430	12	902.450	926.450
13	902.460	926.460	13	902.480	926.480
14	902.490	926.490	14	902.510	926.510
15	902.520	926.520	15	902.540	926.540
16	902.550	926.550	16	902.570	926.570
17	902.580	926.580	17	902.600	926.600
18	902.610	926.610	18	902.630	926.630
19	902.640	926.640	19	902.660	926.660
20	902.670	926.670	20	902.690	926.690
21	902.700	926.700	21	902.720	926.720
22	902.730	926.730	22	902.750	926.750
23	902.760	926.760	23	902.780	926.780
24	902.790	926.790	24	902.810	926.810
25	902.820	926.820	25	902.840	926.840
26	902.850	926.850	26	902.870	926.870
27	902.880	926.880	27	902.900	926.900
28	902.910	926.910	28	902.930	926.930
29	902.940	926.940	29	902.960	926.960
30	902.970	926.970	30	902.990	926.990
31	903.000	927.000	31	903.020	927.020
32	903.030	927.030	32	903.050	927.050
33	903.060	927.060	33	903.080	927.080
34	903.090	927.090	34	903.110	927.110
35	903.120	927.120	35	903.140	927.140
36	903.150	927.150	36	903.170	927.170
37	903.180	927.180	37	903.200	927.200
38	903.210	927.210	38	903.230	927.230
39	903.240	927.240	39	903.260	927.260
40	903.270	927.270	40	903.290	927.290
41	903.300	927.300	41	903.320	927.320
42	903.330	927.330	42	903.350	927.350
43	903.360	927.360	43	903.380	927.380
44	903.390	927.390	44	903.410	927.410
45	903.420	927.420	45	903.440	927.440
46	903.450	927.450	46	903.470	927.470
47	903.480	927.480	47	903.500	927.500
48	903.510	927.510	48	903.530	927.530
49	903.540	927.540	49	903.560	927.560
50	903.570	927.570	50	903.590	927.590
51	903.600	927.600	51	903.620	927.620
52	903.630	927.630	52	903.650	927.650
53	903.660	927.660	53	903.680	927.680
54	903.690	927.690	54	903.710	927.710
55	903.720	927.720	55	903.740	927.740
56	903.750	927.750	56	903.770	927.770
57	903.780	927.780	57	903.800	927.800
58	903.810	927.810	58	903.830	927.830
59	903.840	927.840	59	903.860	927.860
			60	903.890	927.890

Given the apparent hodgepodge freq assignments for this band, it's probably best searched in 5 KHz steps.

The "American Scannergram" is the official publication of the **All Ohio Scanner Club, 50 Villa Rd; Springfield, Ohio, 45503-1036**. The "American Scannergram", while definitely focused on the state of Ohio and surrounding areas, is a nicely assembled and edited newsletter of wide appeal on the total spectrum of scanning. Its main appeal seems to be local frequencies and radio activities, but its also big on equipment reviews, scanning techniques and principles. It's probably a "must" for the library of the complet scannist. The motto of the AOSC is, "*In God We Trust, All Others We Monitor.*"

UPDATE PRO-2004 Parts May Be Gone!

The PRO-2004 was replaced by the PRO-2005 in May, 1990. Radio Shack supports a product for five years after discontinuance. The "*Cinderella Hour*" is coming up fast. In fact, reader Bob Horvath reports Tandy is out of stock on the PRO-2004 Electroluminescent Panel, part # GE-85D-6067 given in WSR, VIN2P7. I'm not sure the bewitching hour has hit yet because I have been using an updated part number for a couple of years now: **GE-86D-6011**

But, update your PRO-2004 Service Manuals on page 53, Item #43, to show this new part number. While you're at it, it would be a good idea to order a spare EL panel or two, perhaps a new front panel, metal case and keyboard cover, and even a whole new keyboard.

The below PRO-2004 items get the most wear and tear and will be impossible to find when Tandy cuts support of the PRO-2004. Tandy Parts: (800) 442-2425

EL Panel	GE-86D-6011
Escutcheon Assy	GA-86D-6385
Cabinet	GE-86B-6360
Panel, Keyboard	GE-86D-6359
PCB Assy, Keyboard	GA-86D-6320
Knobs, Vol & Squelch	GE-86D-6356
Knobs, Dimmer & SSq	GE-86D6357
Antenna, Telescopic	GE-86D-6519
Vol & Switch Ctrl	5M1411-50KA-20A
Squelch Ctrl	K1611008TE-10KC-20
PRO-2004 Service Manual	20-119

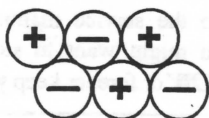
Refer to the service manual for anything else you might want to stock up on and order **NOW** or forever keep your peace!

**BC100XLT/200XLT
NiCd Battery Replacement**
By Greg Strauss

I've had my Uniden BC 100XLT for about 5 years, and the NiCd pack finally went out. So I called Uniden Parts and they wanted \$37.00 for a new battery pack when all I wanted was the NiCd cells from the inside. Uniden won't sell the NiCd's separately. I thought that it would be the cheaper route to go by soldering the NiCd's in myself and not having to buy the whole pack (BP205).

I looked through some electronic supply magazines for the replacement part (Sanyo Model #6N-550AA, 7.2V, 600mAh) with no luck. Then I opened my Radio Shack catalog and found a cordless phone replacement NiCd pack (Cat# 23-193). This pack consisted of only 3 AA NiCd's at 3.6 volts but at 650mAh, which is 50-mAh better than the original. I bought two of these replacement packs from Radio Shack at \$9.99 each for a savings of \$17.00. Here is what I did to polish off the job:

1. Disconnect power supply from rear.
2. Slide the battery pack off the bottom.
3. Remove the two screws from the bottom of the battery pack.
4. Slide the front panel off of the battery pack. Be sure to pull the front panel straight off making sure you do not break the two top tabs.
5. Slide the battery pack out of the case. (The 6 AA NiCd battery pack is encased inside heat shrink wrap.)
6. Cut the two wires as close to the battery as possible. (I kept the wires connected to the printed circuit board because it looked even more difficult to get that baby out)
7. I removed some of the adhesive backed cushioning from the inside of the battery pack to make room for the new batteries.
8. I took the two new battery packs and wired them in series, so I had a positive and negative lead left.
9. Now the old battery pack end view looked something like this:



with the batteries staggered. Keep this in mind when placing the new batteries in the case.

10. Now this is the tricky part. Look at the inside of the battery pack lid. You will notice three round shaped tabs that were used to hold the old battery pack in place. You will need to trim these down in order for the new NiCd's to fit. I used my wire cutters which worked fine.
11. I connected and soldered the positive and negative leads and used heat shrink to cover them.
12. Now remember the note in 9. You will need to place the separate NiCd packs in the case as such.
13. Things may fit a little tight but it will work. Just be careful when replacing the lid back on the pack. I used some heat shrink to hold the new NiCd's together but it was too big for the case. So I used a piece of tape to hold them together.

I charged the new battery pack for 14 hours and had an 11 hour use time. Not bad for a little work.

Editor's Comments: Nice piece of work, Greg, and very inventive! I included the BC-200XLT in the title of your article because the battery packs are the same, and the radios are mechanically the same for all practical purposes. Your procedure will generically work for most any "sealed" NiCd pack, too. For those who want to save even more bucks the individual cells shouldn't cost more than about \$2 each, if you can find them. It might also be possible to beef up the pack up even more with use of nickel-metal hydride cells or heavy duty NiCds.

Good places to start the search for individual replacement cells include:

- Alexander Batteries (619) 480-4445
- Sanyo Energy Co (619) 661-6620
- Metro West (708) 354-2124

Note that MetroWest was big on supplies for the BC-100XLT and 200XLT, including a 1000-mAh rechargeable pack. I haven't heard anything from them in a long time and they may now be out of business. Something to check....

Also note that any beefing up of the NiCd cells must be accompanied by a beefed up recharger. The stock recharger may be fine for 50-ma more like Greg's, but any more than that, and we have to redesign some of the charging circuit for higher current.

FROM THE READERS

FINDING THINGS IN PRO-2006

From: Thomas Nichols, Indianapolis, IN

Hello, Dr. Rig. In regards to headphone audio for the 2004 and 2005 (Book #1, Mod #8, page 103), my 2006 has black, white and gray wires to the headphone jack, but no ground lug on jack, nor could I find the 270 ohm resistor.

ED: In the PRO-2006, the black (middle) wire is the ground wire that runs from the shell of the head-phone jack to pin 3 of CN-6. R-228, the 270Ω resistor, is physically connected between Pin 3 of CN-3 and ground, but it's a chip resistor located on the bottom side of the main receiver board between C-222 & C-226. You do have the Service Manual, right?

Also, on 2005 squelch improvement, I couldn't find R-152 on my 2006. On the 2006 there is a metal sheet (frame) with a PC board mounted on it covering the bottom where the IC-2 is mounted above.

ED: R-152, 33-kΩ, is a chip resistor physically installed between Pin 12 of IC-2 and Pin 1 of IC-10 on the bottom side of the main receiver board. There is an opening in the chassis nearby where you can access R-152 at an angle. The alternative is to remove the main receiver board from the chassis. On the other hand, IC-10 is a new addition to the PRO-2006 that eliminates the need for a Squelch mod. This has been treated in back issues of the WSR.

Also, is there another BFO for mounting inside the set?

ED: Not sure what you mean. There are no BFO's for the PRO-scanners, period.

Do you know about the new BC-9000?

ED: It's a piece of junk with all its bells and whistles coming from firmware; not hardware. Firmware is a cheap way of making a scanner (or other electronic equipment) look great. Caution advised!

CALLER ID & SCANNERS ?

From: Robert Pyle, Miamisburg, OH

Is caller I.D. data transmitted by the base of a cordless telephone? Is it possible to connect a caller I.D. display to a 2006?

ED: I don't know much about CID because California won't allow it. People's rights here are subsidiary to the rights of Big Business, Government, and special interest groups, including all minorities and politicians. Some are more equal than others.

IMPOSSIBLE CELLULAR MODS

From: Mrs. Gary Cribley, Thomaston, CT
 We have a PRO-2030 scanner. On Christmas day my husband wanted to restore cellular to our new scanner. He followed your instructions in V3N9, (Oct '93) but there is no L201 jumper! Is there another modification for the newest PRO-2030? If so, could you put it in your next issue of the WSR. Thank you

ED: *Either it's there and you haven't found it, or else you bought that scanner AFTER March, 1994, when it became illegal to sell cellular-capable scanners. Existing stocks could be sold, but it's likely that Radio Shack pulled them or sold out before the deadline. New models imported or manufactured after 3/94 cannot be "easily modified", and to the manufacturers, that means impossible. 'Fraud you're outa luck.*

From: David Cobb, Smithfield, NC

Bill: I recently tried to unblock cellular coverage on a PRO-2026 AND A PRO-2030. I have done this before, but on these at the L201 location there was nothing but two empty holes in the circuit board. CAN YOU HELP ME? If you know any other way to restore cellular on these two units, please let me know. (Units were purchased 12/94).

ED: *See above. You're S.O.L., too.*

COST OF BLUE LEDs DROPPING

From: Fred Jacobson, Wenatchee, WA

The price of Blue LEDs is getting lower. Check out Digi-Key's newest prices!

800-344-4539

DigiKey Blue LED Prices

	Quantity ⇄	1	10	100	500
100CR-ND T 1½ diffused		.88	7.83	60.75	243.00
101CR-ND T-1½ clear		.88	7.83	60.75	243.00
102CR-ND T-1 diffused		.88	7.83	60.75	243.00
103CR-ND T-1 clear		.88	7.83	60.75	243.00

No min order, \$5 handling charge on orders less than \$25.00. Foreign orders add \$5.00. No shipping US & Canada.

ED: *Great Boogley-Woogley! I'll say the price has dropped! Thanks!*

Service Manuals & BC-2500XLT

From: Don Alesch, Jr., Menasha, WI

Dear Bill, Just a quick note on your response to Mr. Schlegel on page 6 of V5N1. I did send you a Service Manual for the BC-2500 back in Sept '93. "Anyone" learned to teach this thing any tricks such as Mr. Schlegel requested?

ED: *Much of the time we're sent partial and/or poorly reproduced copies of service manuals which get promptly flung without hesitation into the nearest circular file. I retain and study only full and complete copies in good, readable condition. In any event, I know little of the BC-2500XLT and have no idea if anyone else has probed it. It would seem not; else I'd have heard about it...I'm all ears to that sort of thing. ☺*

EXTENDED MEMORY MODS

From: Todd Penney, Nova Scotia Can one buy a preassembled, pretested 6,400-ch extended memory board with the KMBC MOD-28 for the PRO-2006. If so, what would be the cost of this board and would Vols 1 & 2 of the Scanner Modification Handbooks be adequate for the installation?



ED: *At various periods of my Life, I sat down and made up reassembled circuit boards for the various mods. I've been so busy over the last couple of years that this has had to take a back seat and none are presently available other than the CE-232 Interface and the MOD-44 Data/Tone Squelch. However, I have refined the Extended Memory mods to eliminate the need for boards and most wires altogether. This has been thoroughly documented in back issues of the WSR. The mods in my books are certainly more than adequate if you want to go that way; otherwise, research the WSR back issues and apply my new techniques for an incredibly easier job of most any Extended Memory mod.*

Within each of the 16 switchable blocks can you operate your scanner as a normal scanner of 400 channels with 10 banks? i.e. switch into Block 3, have only banks 4,5, & 9 on and have 50 of 120 channels locked out?

ED: *Indeed! That's part of what my Extended Memory Mods are all about! The 16-Block, 6400-ch Mod is like having sixteen scanners lined up in a row with one useable at a time.*

PS What's this about 25,600 channels?

ED: *That's what I mean about the back issues of the WSR! Try 64-Blocks of 400-channels each for less work and equal or slightly higher cost than the old MOD-16 in my books! It's all in the back issues and cannot be repeated again soon for obvious reasons. The new techniques call for surface mount memory chips instead of DIP types!*

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CITY:		STATE:	1991 (1st Year, Jan-Nov/Dec)-----10 ea \$20.00 \$	
ZIP:			1992 (2nd Year, Jan-Nov/Dec)-----10 ea \$21.00 \$	
Work Ph: () - Career or			1993 (3rd Year, Jan-Nov/Dec)-----10 ea \$23.00 \$	
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TYPE OF SCANNERS >>			1991-94 (All the above)-----40 ea \$79.00 \$	
& Other Radios >>			WSR CURRENT SUBSCRIPTIONS	
METHOD OF Check Cash M.O. Visa MstCard COD (+ \$8.50)		Amount Enclosed	Half Year 5 ea \$15.00 \$	
PAYMENT >> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>		\$	One Year 10 ea \$25.00 \$	
Credit Card		Amount Charged	Two Years 20 ea \$45.00 \$	
Acc't No: >> - - - - -		\$	OTHER PRODUCTS	
Name of Issuing Bank		Expiration /	Scanner Mod Hndbk, Vol-1: \$17.95 + \$4.00 S&H *	\$
Date: /			Scanner Mod Hndbk, Vol-2: \$17.95 + \$4.00 S&H *	\$
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X			* Canada US\$6 S&H; Other Foreign US\$9 S&H; all add extra for Air	\$
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			TOTAL THIS ORDER: >>>	\$

STOCKING UP ON PARTS

From: Tony Thornton, Mize, MS

Hi Bill & Cindy; After Getting my PRO-2006 and using it for a while now, I can see why so much praise has been bestowed upon it in the scanner community/press. I chose the 2006 over the 2035 although I will most likely get a 2035 later.

ED: See the recent back issues where we covered the PRO-2035, a clearly worthwhile scanner. I don't know that it beats the 2006, probably not, but it still has advantages, some pretty powerful.

But, I want to continue to use the 2006 for many years so this leads to the reason for my letter. Could you, during the next year when you have time & space in the WSR, list some recommended parts to buy and "stock" for the PRO-2006. I am concerned that parts might be discontinued in the future and some of us might want to get some spares to keep on hand. You know, the stuff that is only available from Tandy.

ED: See my brief on page 5 this month for the PRO-2004! What timing! The PRO-2006 should be supported by Tandy for another 4-yrs, so there's no hurry, but your concern is certainly valid. Use my list for the PRO-2004 as a general guide and translate the part numbers to those for the PRO-2006 and you'll have ample preparation.

EL PANEL CONSIDERATIONS

Does age still kill the display even if the light is seldom used?

ED: Darn good question, and I don't know for sure. The EL Panel is electrochemically active when 80-110 VAC is applied to it. Chemistry is one of those areas where age & environmental factors clearly play a role. I would advise spare EL Panels to be seal-wrapped and stored in the refrigerator, but there's little you can do for the one in the scanner short of keeping it off.

After seeing how they illuminate the PRO-2035's LCD Display with LED's, I may try to work up a similar scheme for the PRO-2004/5/6 and 2021/2022, etc. Shouldn't be difficult, but we need a source of frosted glass or plastic in order to make it feasible. The LCD Display module is clear, as you may know. Bright LEDs behind clear glass would be obnoxious without something to diffuse and spread the light a little.

List some tips to make the 2006 last forever. (joke! ☺)

ED: Serious business, if you ask me. The single best thing you can do is use 12-14 vDC from an external power supply and don't use the AC supply. Otherwise, keep it clean and cool. It should last a long time and at least until its been antiquated by the next wave!

Also the PRO-43 seems to be less sensitive than my other scanners. Can VHF low band sensitivity be improved? By me? If not, is there a technician I can send it to that might be able to help it a little? Other than this, I love the PRO-43 because what you hear is really there. Thanks for a great newsletter and keep those mods coming.

ED: There's nothing you can do unless to **undo** something you may have done to wreck the sensitivity. Did you resolder the antenna wire inside after doing the cellular and other mods? Not doing so will be a killer on the sensitivity. There may be a way for you to perform a basic realignment with the aid of an S-Meter, but I haven't transcribed the procedures into layman's lingo yet and there has been no demand. If your PRO-43 isn't seriously hacked, I'd suggest sending it to a Radio Shack service center for an alignment. The antenna is important, though, and one cut for VHF-Lo will do more than anything to snag those elusive signals that you think you're missing.

NEXT ISSUE WILL BE LATE

Normally, we take June and December off. This one time, we're taking off in March. V5N3 will be mailed in late March or early April so as to give me the much needed time to finish my third book *The Ultimate Scanner*. We'll be back on schedule by July with V5N6 mailed in that time frame. We won't take May off as is our usual custom. In no case will you miss any issues.

MY BOOK IS PROGRESSING

But the graphics and detail are incredibly slow and painstaking, much slower than for my first two books where quality was not the highest item on that publisher's list of priorities. I have a new publisher now, who is the *cat's meow* for quality and doing things right. Since he's that way, I can be no less so. Good things come in due time. *Watch!* ☺

2/1/95 ~ 5:47 PM ~ The "World Scanner Report" © 1991-95; Volume 5, No 2; Page 8



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Remember - Next Issue Will Be Late

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- + 900 MHz Cordless Phone Freqs for Panasonic & Reaslistic
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